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Addressing Climate Change Mitigation and Adaptation Together: A Global Assessment of Agriculture and Forestry Projects

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Abstract Adaptation and mitigation share the ultimate purpose of reducing climate change impacts. However, they tend to be considered separately in projects and policies because of their different objectives and scales. Agriculture and forestry are related to both adaptation and mitigation: they contribute to greenhouse gas emissions and removals, are vulnerable to climate variations, and form part of adaptive strategies for rural livelihoods. We assessed how climate change project design documents (PDDs) considered a joint contribution to adaptation and mitigation in forestry and agriculture in the tropics, by analyzing 201 PDDs from adaptation funds, mitigation instruments, and project standards [e.g., climate community and biodiversity (CCB)]. We analyzed whether PDDs established for one goal reported an explicit contribution to the other (i.e., whether mitigation PDDs contributed to adaptation and vice versa). We also examined whether the proposed activities or expected outcomes allowed for potential contributions to the two goals. Despite the separation between the two goals in international and national institutions, 37 % of the PDDs explicitly mentioned a contribution to the other objective, although only half of those substantiated it. In addition, most adaptation (90 %) and all mitigation PDDs could potentially report a contribution to at least partially to the other goal. Some adaptation project developers were interested in mitigation for the prospect of carbon funding, whereas mitigation project developers integrated adaptation to achieve greater long-term sustainability or to attain CCB certification. International and national institutions can provide incentives for projects to harness synergies and avoid trade-offs between adaptation and mitigation.

Keywords REDD+ · Emissions · Vulnerability · Landscape · Ecosystem services · Livelihoods

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Introduction

As responses to climate change require both mitigation and adaptation, several studies have argued that projects and policies should aim to avoid trade-offs and maximize synergies between the two approaches (Kok and De Coninck 2007; Swart and Raes 2007; Ayers and Huq 2009). Adaptation and mitigation share the ultimate purpose of reducing climate change impacts but have different objectives: mitigation aims to reduce emissions or enhance the sinks of greenhouse gases, while adaptation addresses the effects of climate change on people and ecosystems (Tol 2005). Because of their different objectives and scales, adaptation and mitigation tend to be considered separately in projects and policies (Klein et al. 2005) and synergies and conflicts between adaptation and mitigation are not often mentioned (Berry et al. 2015). Agriculture, forests, and other land use (AFOLU) activities are relevant to both mitigation and adaptation, because they emit or capture

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greenhouse gases, are vulnerable to climate variations, and provide goods and services that are central to the adaptive strategies of local communities and reduce the vulnerability of local communities and broader society to climate variations (Ravindranath 2007; Guariguata et al. 2008; Locatelli et al. 2011; Matocha et al. 2012).

Considering both adaptation and mitigation in climate change initiatives could help avoid trade-offs that could occur otherwise (Suckall et al. 2014; Harvey et al. 2014; Duguma et al. 2014a; Berry et al. 2015). For example, a forest plantation project that sequesters carbon for mitigation can reduce water availability for downstream populations and increase their vulnerability to drought. Failure to consider mitigation in adaptation initiatives may lead to adaptation measures that increase greenhouse gas emissions, which is one type of maladaptation, according Barnett and O'Neill (2010) and the fifth assessment report of the IPCC (Porter et al. 2014, p. 518): "key maladaptation would be one which increased emissions of greenhouse gases". Similarly, we could use the term "malmitigation" for an initiative that reduces greenhouse gas emissions but increases vulnerability.

Several benefits of addressing adaptation and mitigation jointly in projects and policies have been mentioned in the literature. For example, integrating adaptation into mitigation projects may increase their resilience to climate variations, the permanence of carbon storage, and their acceptance by local communities, as adaptation responds to local issues (Locatelli et al. 2011, 2015; Duguma et al. 2014a; Suckall et al. 2015). Project developers could access alternative sources of adaptation and mitigation funding and, if mitigation projects produce adaptation outcomes, carbon funding could bridge the adaptation funding (AF) gap (Matocha et al. 2012). Another advantage would be to improve the cost effectiveness of the overall climate change funding (Ravindranath 2007; Suckall et al. 2015). However, concerns have been raised about the feasibility of pursuing adaptation and mitigation together, the associated transaction costs, and the failure risk of overambitious and complex projects (Klein et al. 2005, 2007; Swart and Raes 2007).

In 2012, approximately one billion US$ was committed globally to activities aiming at both adaptation and mitigation, out of a total of 80 billion US$ of climate finance committed by the International Development Finance Club, a network of national and subregional development banks, but no detail is available on the joint mitigation and adaptation activities (Ecofys-IDFC 2013). According to the OECD's Creditor Reporting System on aid activities for the global environment (which describes whether adaptation and mitigation are primary or secondary goals of funded activities), 22 % of funding to forestry and agriculture between 2010 and 2012 had both adaptation and mitigation as either primary or secondary goals (OECD 2014). As this funding includes broad institutional support, which reports contributions to all available environmental goals, more analysis is needed to understand the degree of integration of adaptation and mitigation.

Several emerging approaches to development (e.g., climate-smart development or climate-compatible development) consider adaptation and mitigation jointly (Someshwar 2008) and can be applied to agricultural landscapes (Harvey et al. 2014) or forestry (Locatelli et al. 2015). Previous studies have assessed how specific AFOLU activities can contribute to mitigation and adaptation, for example, agroforestry (Schoeneberger et al. 2012), and how policies and financial mechanisms can incentivize AFOLU projects that address adaptation and mitigation simultaneously (Duguma et al. 2014b). Some studies have shown that forest mitigation projects rarely consider adaptation (Guariguata et al. 2008; Reyer et al. 2009) and others have called for more research on the conditions under which adaptation and mitigation goals can be effectively integrated in AFOLU activities (Dang et al. 2003; Klein et al. 2007; Verchot et al. 2007; Locatelli et al. 2011).

To start filling the knowledge gap on the integration of adaptation and mitigation in AFOLU projects (Suckall et al. 2015), this paper analyzes whether existing climate change projects in agriculture and forestry consider both adaptation and mitigation goals. Given that the separation of adaptation and mitigation in policies and funding is mirrored at the project level (Duguma et al. 2014a; Suckall et al. 2015), most climate change projects are designed for only one of the two goals, which represents a missing opportunity to address climate change more efficiently and holistically. Knowledge is missing on whether these projects also consider the other goal or could contribute to it.

Our objective was to analyze how climate change project design documents (PDDs) considered a joint contribution to adaptation and mitigation in forestry and agriculture in the tropics. More specifically, we analyzed whether adaptation PDDs mentioned a contribution to mitigation or reported future outcomes that could contribute to mitigation (and similarly for the contribution of mitigation PDDs to adaptation). We adopted a semi-quantitative approach for reviewing 201 PDDs describing adaptation or mitigation projects under different portfolios of national programs, global instruments, funds or certification standards. We expected to find that many PDDs would have the potential to demonstrate benefits to both adaptation and mitigation. As in previous studies (Marion Suiseeya and Caplow 2013; Remling and Persson 2014), our analysis focused on what PDDs stated rather than what had actually happened in practice, because of the limited number of climate change projects having been completed, the lack of consistent outcomes reporting for completed projects, and the large number of available PDDs. We assumed that a PDD reflected what a project could achieve in practice under a success scenario. For example, if an adaptation PDD did not mention any activities or outcomes that could potentially contribute to mitigation, we considered unlikely that the implemented project would have an effect on mitigation.

Methods and Data

Project Selection

We searched and downloaded PDDs in major portfolios of climate change projects (Table 1). As these portfolios focused on one climate goal, we recorded the primary goal of the retrieved PDDs, either adaptation or mitigation. For building our database, we selected only projects with forestry and agricultural activities (projects with both, including agroforestry, were labeled "mixed") in Africa, Asia, and Latin America, with PDDs prepared before January 1, 2013, available online in English, French, or Spanish. We excluded PDDs of projects without land management activities (e.g., animal waste management or biogas production) and of national projects on capacity building or institutional strengthening without agricultural or forestry activities on the ground. The PDDs of projects of any scale and at any stage of development were included; however, we recorded the type and length of the PDDs (detailed design documents, identification note, profiles, or concept notes). Our database included 284 PDDs from 79 countries (see list of projects in Online Resource, Sect. 3). Of these, 13 came from two portfolios: 10 verified by two standards [climate community and biodiversity (CCB) plus verified carbon standard (VCS) or plan vivo (PV)], and three registered under the clean development mechanism (CDM) and verified by one standard (CCB or PV).

Because the length of PDDs was likely to influence the extent to which project contribution was described and because adaptation PDDs were significantly shorter than the mitigation PDDs (respectively 45 and 100 pages on average), we excluded the 83 projects that had documents with 15 or fewer pages [including all the 70 national adaptation programme of actions (NAPA) short project descriptions extracted from the national adaptation plans]. With this new set of 201 projects, there was no statistically significant difference in document length between adaptation and mitigation PDDs (respectively 86 and 103 pages on average). In addition, this exclusion of short PDDs avoided double-counting, as many long least developed countries fund (LCDF) project documents originated from short NAPA project description.

The remaining 120 mitigation and 81 adaptation PDDs were distributed across 68 countries (Fig. 1 and Online Resource, Sect. 1). A higher proportion of PDDs aimed at mitigation in Latin America than elsewhere. The sample contained more forestry PDDs (52 %) than agriculture (25 %) and mixed PDDs (23 %). The mixed PDDs were equally split between adaptation and mitigation, whereas agriculture PDDs were exclusively about adaptation and forestry PDDs mainly about mitigation (94 out of 105). PDDs were dated from 2004 to 2012 (68 % from 2010 or after).

Analysis

We employed a mixed methods content analysis where both qualitative and quantitative data were included (like in Marion Suiseeya and Caplow 2013 and Remling and

Table 1 List of selected portfolio and acronyms

Portfolio	Acronym	Goal (*A* adaptation, *M* mitigation)	Type
National adaptation programme of actions	NAPA	A	National plan
Clean development mechanism	CDM	M	International mechanism
CarbonFix	CF	M	Project certification standard
Climate community and biodiversity	CCB	M	
Plan vivo	PV	M	
Verified carbon standard	VCS	M	
Adaptation fund	AF	A	International fund
Special climate change fund under GEF	SCCF	A	
Least developed countries fund under GEF	LCDF	A	
Global environment facility other than SCCF and LDCF: SPA-CBA (strategic priority on adaptation for community-based adaptation), SFM (sustainable forest management program)	GEF	Either A or M	

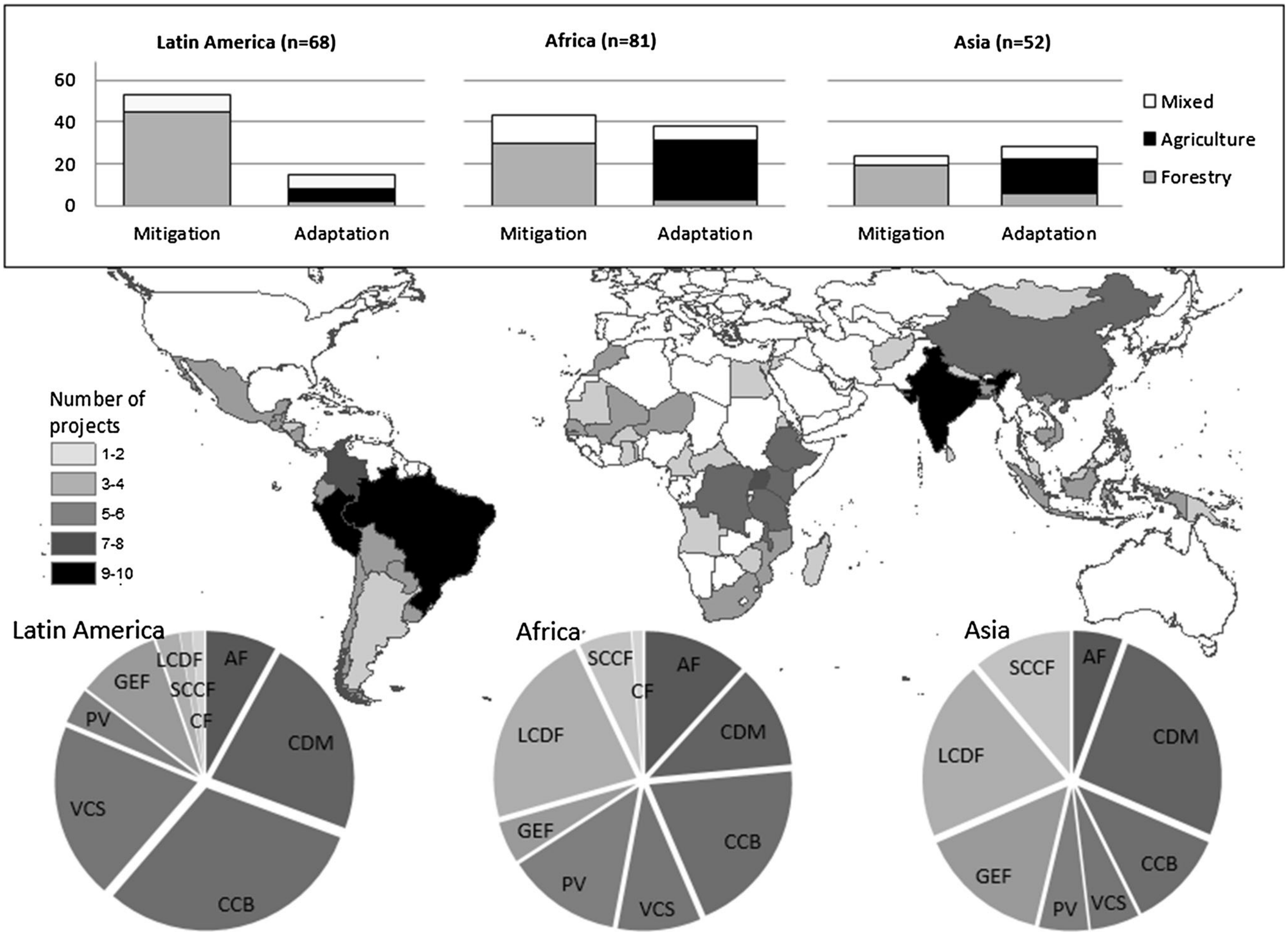

Fig. 1 Distribution of the 201 analyzed PDDs by country (*map*); by region, primary project goal, and sector (*bar charts*); by region and portfolio (*pie charts*)

Persson 2014). First, we browsed all PDDs for coding text excerpts about the expected contribution of projects to adaptation and mitigation goals and about evidence of this contribution (see examples in Table 2). For adaptation, we considered three goals: social adaptation (i.e., reducing the vulnerability of people to climate variations with measures that are not aimed at adapting agriculture or ecosystems), agricultural adaptation (i.e., vulnerability of agriculture), and ecosystem adaptation (i.e., vulnerability of forests and other nonagricultural ecosystems). For PDDs explicitly associating adaptation and mitigation, we coded statements related to the project developers' rationale for doing so.

We defined a degree of explicitness and substantiation to measure how a PDD described contributions to mitigation and the three adaptation goals ("0" if not explicit; "1" explicit but not substantiated; "2" explicit and substantiated). We considered that a contribution was substantiated if the statements about this contribution were supported by evidence from literature, field observations, expert and stakeholder interviews, or model results. Using analyses of variance, we assessed whether this degree depended on its primary goal (adaptation or mitigation), the sector (forestry, agriculture, or mixed), the portfolio and the location (continent), after controlling for the effect of the length of PDDs because longer PDDs were likely to have a more explicit and substantiated contribution. This analysis aimed at highlighting what factors influenced how projects reported their contribution to adaptation and mitigation, for example, whether adaptation projects were more likely to report a contribution to mitigation than the contrary or whether standards influenced the joint consideration of adaptation and mitigation.

Second, regardless of whether a contribution was explicit and substantiated, we analyzed whether PDDs described outcomes that could potentially contribute to adaptation and mitigation goals. For this, we established a list of project outcomes based on a literature review, and after grouping them, selected 36 outcomes (Table 3). The literature was not a systematic review in the strict sense: we iteratively searched papers and read them to build a list of

Table 2 Examples of statements in the project documents about explicit and substantiated contributions to the two climate change goals

Goal	Examples of explicit contributions	Substantiation
Social adaptation	The project objective is to reduce the vulnerability of communities to climate change. The project will empower subsistence farmers to combat the effects of drought	Project proponents have assessed the vulnerability of livelihoods to climate variability and climate change. Specific activities, groups or communities are identified as the most vulnerable within the region
Agricultural adaptation	The project will enhance the climate resilience of the agricultural sector by improving water and land management. The project will introduce agro-ecological practices that help reducing agricultural vulnerability to climate change	Project proponents have assessed the vulnerability of agriculture and food production systems to climate variability and climate change and identified key threats
Ecosystem adaptation	Project activities will reduce fire risk in forests. The project will plant native trees that are resistant to floods. Climate change risks are reduced through planting a mix of species. Protecting continuous forests across altitudinal ranges will assist species in adapting to climate change by allowing migration	Project proponents have assessed the vulnerability of forests, mangroves or other ecosystems to climate variability and climate change and identified key threats
Mitigation	Reforestation will lead to the long-term sequestration of atmospheric carbon in biomass and soils. The project aims to halt deforestation and its associated greenhouse gas emissions	Project proponents have estimated potential carbon sequestration or emission reductions

outcomes until we reached a point of saturation where no new relevant outcomes came to light. We then browsed the full PDDs and coded statements related to these outcomes. For all PDDs, each of the 36 outcomes was scored: "0" if not mentioned; "1" if explicitly mentioned; or "2" if mentioned explicitly and substantiated. We also recorded qualitative descriptions of the outcomes for providing examples. Following Marion Suiseeya and Caplow (2013), the coding procedure of the PDDs was applied by the three authors on the same small subset of the project documents before discrepancies in the procedures were discussed among authors and reconciled. Then authors worked on separate subsets of project documents.

Results

Contribution of Adaptation PDDs to Mitigation

Few adaptation PDDs considered mitigation explicitly. Only 24 of the 81 adaptation PDDs (30 %) explicitly mentioned a contribution to mitigation (Fig. 2), such as increasing carbon stocks in trees through afforestation, reforestation, and agroforestry or increasing soil carbon through land management. For example, in one adaptation PDD in Togo (with the identifier P017 in Online Resource, Sect. 3) within the AF portfolio, mitigation benefits were reported from the sustainable management of degraded forests, but it was recognized that this was not the priority of the project.

Most adaptation PDDs could potentially report a contribution to mitigation. The majority of adaptation PDDs (73 out of 81 or 90 %) reported mitigation-related outcomes, such as increased carbon storage in forests, soils or agricultural vegetation, and reduced carbon losses in forests. For example, an adaptation PDD in Colombia (P002) proposed climate change-resilient agricultural practices (agricultural adaptation) and ecosystem restoration with native trees resistant to flood conditions (ecosystem adaptation) to reduce floods in downstream communities (social adaptation). Several expected outcomes could likely result in increased carbon storage in soils (e.g., soil restoration, decreased erosion, and improved fertility) and trees (e.g., agropastoral systems and reforestation).

A few adaptation PDDs did not report any outcomes with a potential for mitigation. Among the 57 adaptation PDDs that did not state an explicit contribution to mitigation, eight (Fig. 2) had no outcome potentially contributing to mitigation and were agriculture projects aimed at improving technology and practices (e.g., crop varieties, water management) or infrastructure (e.g., irrigation canals, coastal dykes). The other 49 (Fig. 2) could mention a contribution to mitigation if there were any interest or benefit in doing so.

Most adaptation PDDs that integrated mitigation did not explain the motivations of project developers for doing so. Mitigation was considered as a side effect in most adaptation PDDs with explicit contribution to mitigation, without further analysis of what opportunities this may represent. For example, project proponents in Eritrea (P014) mentioned that the project "will result in increased carbon sequestration" as an added benefit. One PDD in Bolivia (P034) presented mitigation as a possible funding source ("creating a future plan for carbon compensation"). In two PDDs, mitigation was perceived as a way to scale-

Table 3 Goals and outcomes used in the project analysis

Goal	Project outcomes that can potentially contribute to the goal	Sources (primary sources in bold)
Social adaptation	15 Outcomes: livelihood diversification[acde]; income[acde]; health[f]; energy[abe]; tenure and rights[ca]; food security[ghc]; clean and reliable water[abe]; market access[ac]; education and capacity[aci]; disaster risk reduction[bi]; protective infrastructure[bi]; protective ecosystems (against landslides, floods, etc.,)[bcdi]; resilient infrastructure and housing[bei]; strengthened institutions (incl. policies) and social networks[aj]; gender and women's empowerment[kl]	[a]**Below et al. 2012, Tables 2–6** [b]**Noble et al. 2014, Sect. 14.3** [c]Pramova et al. 2012, cases [d]Matocha et al. 2012, Table 1 [e]Angelsen et al. 2014 [f]Smith et al. 2014 [g]Porter et al. 2014, Sect. 7.5 [h]Easterling et al. 2007, Sect. 5.5 [i]Zou and Wei 2010, Table 6 [j]Adger et al. 2011, Table 1 [k]Terry 2009, especially pp. 101–110 [l]Rocheleau and Edmunds 1997
Agricultural adaptation	Six outcomes: agricultural water management; resistant or diversified crops and varieties; farming practices for increased resilience; post-harvest management; resistant farm animals; trees on farm for crop or animal resilience	**Clements et al. 2011, Table 1.1** **Below et al. 2012, Tables 2–6** Cruz et al. 2007, Table 10.8 Rosegrant et al. 2010, pp. 72–76 Porter et al. 2014, pp. 513–520 Pramova et al. 2012, case 2 Matocha et al. 2012, Table 1 Anderson and Zerriffi 2012, Table 1
Ecosystem adaptation	Five outcomes: protection against climate-related disturbances (e.g., fires, pests); reduced human pressures on ecosystems or restoration of degraded ecosystems; connectivity between ecosystems at the landscape scale; management of production forests and plantations for increased resistance or resilience; management of agroforestry systems and multiple use forests for increased resistance or resilience	**Reyer et al. 2009, pp. 27, 28** **Guariguata et al. 2008, Table 1** Ravindranath 2007, Table 1 Locatelli et al. 2008, Table 1 Easterling et al. 2007, p. 295 Matocha et al. 2012, Table 1
Mitigation	Ten outcomes: reduced carbon losses in ecosystems; carbon storage in ecosystems; carbon storage in products; carbon storage in soils; carbon storage in agricultural vegetation; reduced N_2O/CH_4 emissions from soils; reduced N_2O/CH_4 emissions from vegetation; reduced N_2O/CH_4 emissions from animals; reduced N_2O/CH_4 emissions from animal and plant waste; reduced emissions from energy	**Smith and Bustamante 2014, p. 11.3** Börner and Wunder 2012, Table 1 Ravindranath 2007, Table 1 Uprety et al. 2012, Table 1.1 Smith and Olesen 2010 Rosegrant et al. 2010, pp. 56–72 Matocha et al. 2012, Table 1 Anderson and Zerriffi 2012, Table 1

up adaptation: project developers in Cambodia (P001) and Uruguay (P010) planned to explore whether reducing emissions from deforestation and forest degradation (REDD+) could help promote adaptation at a larger scale (stating, in Uruguay, that "adaptation should be the most relevant plan of action" for the country). Two other PDDs, in Ghana (P071) and Togo (P017), mentioned the cost effectiveness of pursuing adaptation and mitigation jointly. However, the project developers in Togo highlighted possible trade-offs between the two goals and commented that their approach did "not optimize mitigation".

Contributions of Mitigation PDDs to Adaptation

Nearly half of the mitigation PDDs explicitly reported a contribution to adaptation. Among the 120 mitigation PDDs, 43 % explicitly stated a contribution to adaptation, and 31 % substantiated it (Fig. 2). Contributions were

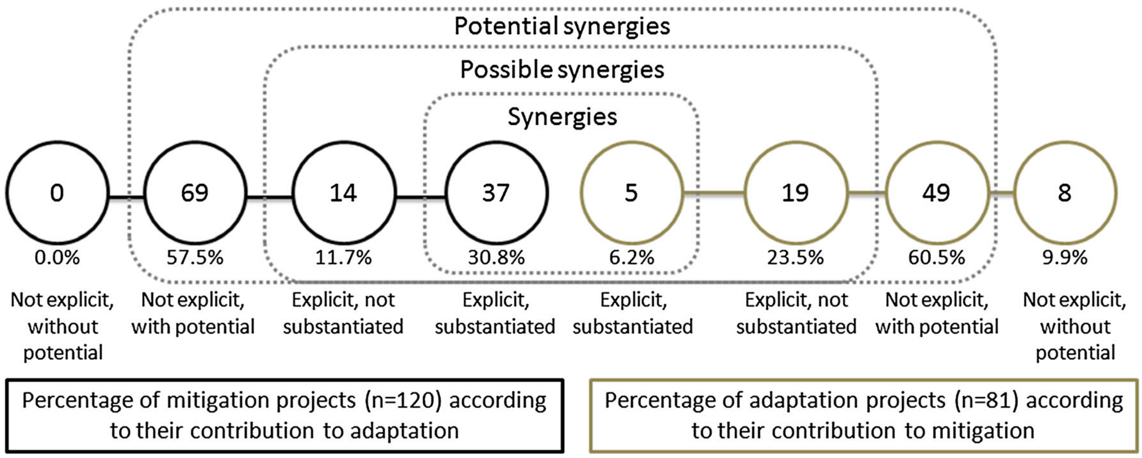

Fig. 2 Distribution of adaptation or mitigation PDDs according to their explicit, substantiated, and potential contributions to the other goal

mainly related to social adaptation (33 %) and more frequently to the adaptation of ecosystems (23 %) than agriculture (16 %), because most mitigation PDDs were forestry or mixed rather than agricultural.

All mitigation PDDs had an outcome that could potentially contribute to at least one adaptation goal. Almost all (98 %) could contribute to social adaptation, especially through education and capacity building, livelihood diversification, and increased incomes. For example, a mitigation PDD in Zimbabwe (P110) describe increased income and diversified nonagricultural activities such as beekeeping as an adaptation measure and an alternative to wood harvesting, a driver of forest degradation. All mitigation PDDs reported potential contributions to ecosystem adaptation, especially through increased connectivity between forests at the landscape scale, reduced human pressures on biodiversity, management of climatic disturbances such as fires and the plantation of native species or species resistant to climatic stressors such as droughts. For example, according to its PDD, a community carbon project in Mozambique (P090) aimed at restoring and protecting natural forests and biodiversity, reforesting for increasing landscape connectivity, harvesting timber sustainably, and creating firebreaks and patrols. More than half of the mitigation PDDs (55 %) also reported potential contributions to agricultural adaptation, particularly through agroforestry, improved water management, and livestock or farming practices that improve resilience. For example, a mitigation PDD in Indonesia (P087) proposed forest conservation with agricultural activities for water conservation, irrigation, improved technologies, and multispecies agroforestry systems. The potential contribution to agricultural adaptation often resulted from agricultural activities and sometimes from other activities, e.g., reforestation of riparian areas in a PDD in Brazil (P137) was expected to improve water for downstream irrigation.

Few mitigation PDDs explained their motivations for integrating adaptation (only a quarter of the mitigation PDD with explicit contribution to adaptation). Some project proponents stated that adaptation was needed because of climate change impacts, but it was unclear why the project would address climate vulnerability rather than other vulnerabilities. It seemed that some PDDs addressed adaptation because it was required by the CCB Standards to attain Gold Level certification: there were more projects integrating adaptation in the CCB portfolio than in other portfolios (according to the analysis of variance or ANOVA, see Online Resource, Sect. 2). For example, the PDD of a CCB conservation project in Indonesia (P087) stated that “there is value in adopting a portfolio or mix of strategies that includes mitigation (and) adaptation”, but without further justification, even though the project developers recognized the “expected increasing costs of implementing programs and activities to (adapt to the) impacts of climate change”. Four PDDs included adaptation measures for ecosystems because of the perceived risk of climate variability or change for the permanence of carbon storage. For example, the PDD of a forest conservation project in Paraguay (P086) states that the climate change impacts “may start to be felt toward the end of the project lifetime, potentially affecting carbon stocks”. Adaptation was also integrated into mitigation PDDs when the impacts of climate variations on agriculture were recognized as a threat to projects, ecosystems, and carbon. Examples include a PDD in Kenya (P085), which analyzed that decreased food productivity, if not addressed, would increase pressure on biodiversity, and the PDD of a REDD+ project in Zimbabwe (P110) where “drought threatens the project activities that focus on agricultural improvements”.

Projects Integrating Both Adaptation and Mitigation

A mitigation PDD in our sample was more likely to integrate the other goal explicitly and substantiate it than an adaptation PDD. The degree of explicitness and substantiation was higher in the CCB portfolio than others and lower in the CDM portfolio than others. Project sector and continent did not have a significant influence (see ANOVA results in Online Resource, Sect. 2).

PDDs integrating adaptation and mitigation shared several common features. They recognized ecosystems as providers of multiple services for both mitigation (carbon) and adaptation (watershed protection, forest products for livelihood diversification or safety nets, mangrove protection against storms and waves, microclimate regulation in agricultural fields). These PDDs integrated forestry and agriculture, and often considered a landscape approach (e.g., for enhancing connectivity between forests). They also emphasized outcomes related to livelihoods (including diversification, incomes, education, health, or food security) and institutions (including institutional strengthening, rights, and tenure). In a PDD from Madagascar (P107), both mitigation and adaptation measures "center on improving community forest resource governance, improving subsistence agriculture including agricultural techniques, improving agricultural infrastructure, and crop diversification". In another PDD, in Brazil (P111), strengthening institutions and empowering people are considered as crucial to both adaptation and mitigation.

For example, a PDD from Cambodia (P089) focusing on reducing emissions from deforestation and forest degradation in community forests included activities such as strengthening community capacity, encouraging women's leadership in forest governance, clarifying land tenure, protecting forests to buffer microclimatic changes, and improving groundwater recharge to reduce the effects of droughts. According to the PDD, this project planned to keep a share of the carbon credits in an insurance scheme to cover losses caused by climatic disasters, with communities using non-timber forest products as safety nets. This PDDs also described activities for the adaptation of agriculture (improving farming systems to enhance food security, for example, through improved seed varieties and irrigation) and for the adaptation of ecosystems (e.g., increasing corridors between forest areas, preventing forest fires, and planting species with low sensitivity to changing temperatures).

Discussion

Given the way the international climate policy and funding arenas are structured, most projects in climate change funds, mechanisms or standards pursue either adaptation or mitigation as a primary goal and are labeled as either one or the other (Illman et al. 2013). Nonetheless, our analysis shows that many PDDs consider explicitly the other goal and most of them have the potential to demonstrate a contribution to both climate goals. This result confirms that forestry, agriculture and other land-use activities are key in providing co-benefits for both adaptation and mitigation (Harvey et al. 2014; Locatelli et al. 2015). The approaches described in the PDDs considering both adaptation and mitigation are also highlighted in the literature for their multiple benefits and should be promoted by policies aiming at the integration of adaptation and mitigation. For example, the restoration and conservation of "green" infrastructure provide direct or indirect protection from climate hazards (Biagini et al. 2014): climate projects in AFOLU should promote an ecosystem approach to both mitigation and adaptation and consider a diversity of "adaptation services" delivered by ecosystems (Pramova et al. 2012). Projects should also address institutional issues, such as tenure and rights, which are indeed major challenges for REDD+ and adaptation activities (Toni and Holanda 2008; Robinson et al. 2013). Projects should address common institutional and economic drivers of vulnerability (for adaptation) and emissions (for mitigation) (Young 2010; Amaru and Chhetri 2013). For example, REDD+ and adaptation projects should provide sustainable community benefits (Blom et al. 2010) and protect people's rights, identities and participation in decision making (Sikor et al. 2010).

International funding, guidance, and standards play an important role in the way PDDs address adaptation and mitigation together. For example, mitigation PDDs under the CCB standard more often describe adaptation measures and outcomes, as this standard provides guidance on integrating them and requires adaptation to be addressed to achieve a Gold Level certification. On the contrary, other mitigation guidelines barely address adaptation: CarbonFix (CF) guidelines only mention that all planted species must be site-adapted under changing climate conditions, and the PV guidelines say that mitigation projects can contribute to social and ecological resiliences to climate change. There are few references to mitigation in the guidelines for adaptation project portfolios: for example, the NAPA guidance mentions carbon as a possible benefit (UNFCCC 2002) and the NAPA guidelines recommend assessing mitigation benefits if possible (GEF 2011a). The global environment facility (GEF) AFs LDCF and special climate change fund (SCCF) are not supposed to provide global benefits such as mitigation (GEF 2009), and evaluations of these funds do not address linkages between adaptation and mitigation (COWI and IIED 2009; GEF 2012), which may overlook the benefits of holistic climate projects. On the contrary, SPA projects are expected to provide global benefits (GEF 2009) and an evaluation of this

AF concluded that a few projects included linkages to mitigation (GEF 2011b). The lack of recognition of the contributions of projects to both adaptation and mitigation, and the separation of adaptation and mitigation funds and policies can lead to some projects being split in two parts: one on adaptation, and the other on mitigation. The same activity can be presented in different policy documents as either as an adaptation activity or a mitigation one, for instance, an agroforestry project in Ghana (Suckall et al. 2015).

There appears to be an intrinsic value in integrating adaptation into mitigation projects even without incentives provided by funders, because of reduced climatic risks and increased sustainability, as mentioned by a few project developers. However, most PDDs did not refer to climate risks, which are not yet well perceived, as observed by Reyer et al. (2009) and Guariguata et al. (2012) about mitigation project developers and forest managers. By contrast, there is no clear rationale for a project developer to integrate mitigation into adaptation projects, beyond the perspective of receiving additional support from mitigation funding by selling carbon credits (Klein et al. 2007). Interestingly, some project developers envision that mitigation funding may support adaptation actions if synergies are proven, for example, REDD+ could be used to upscale adaptation, which has also been proposed elsewhere (Peskett and Stephenson 2010). However, the complexity of harnessing additional funding through carbon funds may prevent many adaptation project developers from taking this path (Illman et al. 2013).

The PDDs suggests little to no conflict between adaptation and mitigation and the complexities of addressing adaptation and mitigation jointly are overlooked by most PDDs. Any project design involves trade-offs, for example, among the beneficiaries of different adaptation and mitigation activities or between local and global project stakeholders (Marion Suiseeya and Caplow 2013). For example, some reforestation projects expect improved water availability downstream for reducing peoplés vulnerability, which is not always the case (Locatelli and Vignola 2009). Some mitigation projects claim that carbon revenues will diversify livelihoods and increase household incomes with an effect on the resilience of communities; however, carbon projects or payments for environmental services do not always result in higher household incomes, particularly when the incentivized activities lead to smaller benefits and larger costs for households (Corbera et al. 2007; Locatelli et al. 2008).

The lack of recognition of trade-offs in our study comes from a limitation of our method based on PDDs. Other analyses of PDDs have identified the same limitation, as very few PDDs report adverse outcomes (Marion Suiseeya and Caplow 2013). PDDs are written by project proponents often to compete for funding or to obtain a certification, which may explain why they tend to overlook risks of negative effects and overstate positive aspects (Remling and Persson 2014). When projects integrating adaptation and mitigation are completed, additional research could analyze the actual outcomes and the challenges faced by project developers in practice, as done in Kongsager and Corbera (2015).

Future ground truthing of a sample of implemented projects could help us understand how realized outcomes align with the expected outcomes described in the PDDs. Whereas our assessment informs about potentials for contributing to both adaptation and mitigation, some adjustments in project designs may be needed to achieve actual contributions: for example, livelihood diversification may not automatically contribute to adaptation, and project developers may need to understand more how diversification can reduce people's vulnerability to climate variations. Future ground truthing could allow help in analyzing how project duration and scale influence project outcomes and the integration of adaptation and mitigation.

Our analysis also shows that most PDDs use a complementarity approach (i.e., mitigation projects providing adaptation co-benefits and vice versa) rather than a synergy approach, described by Duguma et al. (2014a) as holistic from the project design to its completion and leading to optimized adaptation and mitigation outcomes. With a synergetic approach, AFOLU projects would be designed to combine adaptation and mitigation in a way that project components interact with each other to generate additional climate benefits compared to projects in which adaptation and mitigation are separated (Duguma et al. 2014b). Mainstreaming climate compatible development (i.e., adaptation, mitigation, and development) may avoid that projects respond to adaptation and mitigation urgencies separately. Scarce resources could be more efficiently spent, for instance, by not establishing separate institutions and processes to support adaptation and mitigation, and by avoiding conflicting policies (Suckall et al. 2015), because a current major challenge in integrating adaptation and mitigation is the institutional complexity (Duguma et al. 2014a).

Conclusions

Adaptation and mitigation are driven by different interests and political economies, with distinct international donors and national institutions. These differences are reflected in the guidelines and requirements that climate change project developers have to follow. Although this institutional setting should have created a clear separation between adaptation and mitigation on the ground, our analysis of the integration of adaptation and mitigation in global portfolios of AFOLU climate change projects showed that many projects are addressing adaptation and mitigation jointly; in particular, mitigation projects integrating adaptation. Some project developers have developed integrated projects that manage multiple ecosystem services, give attention to institutions and livelihoods, and adopt adaptive management to contribute to both adaptation and mitigation.

Many projects have the potential to contribute to both goals or to avoid trade-offs between them, but the institutional setting does not create incentives to search for synergies. International funds and standards can help projects harness synergies or avoid trade-offs between adaptation and mitigation: they could provide more information and technical assistance, or prioritize projects that integrate both goals or assess the costs and benefits of considering the other goal or not, for example, mitigation projects that assess climate risks and decide on integrating adaptation or not. Such approach would not force a marriage between adaptation and mitigation in all projects, which could increase project complexity and costs. However, these actions can improve the overall efficiency of climate funding by delivering joint benefits at local and global levels and avoiding trade-offs.

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